

Prognostication in Traumatic Brain Injury- A Prospective Study of 100 Patients in Tertiary Care Hospital in Rural Area

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ABSTRACT

BACKGROUND

Traumatic brain injury is a major health issue responsible for considerable mortality and morbidity worldwide especially in subjects under the age of 40 yrs. It is important to assess and grade the TBI as soon as possible to guide management and decrease the comorbidities. Various guidelines have been issued by the neurosurgical societies to immediately assess and intervene when ever required. In this study, we have tried to assess the role of basal cisternal effacement in the management and prognosis of RTA patients, and hence tried to simplify the prognostication process and improve the patient management.

METHODS

100 subjects were studied who were having history of traumatic head injury. NCCT was done for all the patients using 128 slice Multidetector CT- Ingenuity (Philips Medical Systems, USA). Other parameters like pupillary reaction, GCS at the time of presentation, midline shift and associated fractures and bleed were assessed. All the patients were followed up till the time of discharge. The data so obtained was analysed.

RESULTS

Parameters like age, pupillary reflex, GCS at presentation, associated intracranial bleed, associated cranial vault fractures and presence or absence of midline shift correlated well with the final outcome with p value consistently <0.05. We analysed that the degree of obliteration of perimesencephalic cistern was a good prognostic marker in traumatic head injury patients. 36% of patients had favourable outcome out of which none of the patients had obliterated perimesencephalic cistern or interpeduncular cisterns. 64% patients had unfavourable outcome out of which 60% and 48% had obliterated or partially obliterated perimesencephalic cisterns and interpeduncular cisterns respectively, and only 4% and 16% had normal perimesencephalic cisterns and interpeduncular cisterns respectively.

CONCLUSIONS

It is important to investigate, grade and prognosticate traumatic head injury patients at the earliest. Our study and various other studies prove that various clinical predictors including age, Glasgow coma scale, and pupil reactivity correlate with outcome of patient. Presence of midline shift, intraventricular haemorrhage, and obliteration of cisterns in patients of traumatic brain injury also correlate with the outcome and can be used; thus, making the prognostication process much easier. These findings can be used on the first day of admission itself.

KEY WORDS

Traumatic Head Injury, Basal Cisterns, Perimesencephalic Cistern Effacement, Prognosis.

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BACKGROUND

Traumatic brain injury is a major health issue responsible for considerable mortality and morbidity worldwide especially in subjects under the age of 40 yrs.^[1] It is important to assess and grade TBI as soon as possible to guide management and decrease comorbidities. Road traffic accidents are the most common cause of traumatic brain injury and contusion is the most common finding found in these patients. In a study conducted with over 280 patients, where Median GCS was found 12 and mean age was around 28-45 years concluded that 52.3% or 148 patients who underwent CT-Scan had brain contusions and 33% or 88 patients who had severe THI showed other intracranial bleed or haemorrhagic patterns on CT. Overall mortality in the study was around 30.9% and among the rest who survived, 80.1% made a good recovery after the injuries.^[2]

According to Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, the following are the statistics from United States- An estimated 1.7 million people sustain a TBI annually. Out of them, 52,000 die, 275,000 are hospitalized, and 1.365 million, nearly 80%, are treated and released from an emergency department. TBI contributes to a third (30.5%) of all injury-related deaths in the United States. Motor vehicle-traffic injury is the leading cause of TBI-related death. Rates are highest among adults aged 20 to 24 years.

Groups at risk for TBI include children aged 0 to 4 years, older adolescents aged 15 to 19 years, and adults aged 65 years and older. Almost half a million (473,947) emergency department visits for TBI are made annually by children aged 0 to 14 years. Adults aged 75 years and older have the highest rates of TBI-related hospitalization and death. In every age group, TBI rates are higher for males than for females.^[3]

Falls are the leading cause of injury among children aged less than 5 years whereas motor vehicle crashes are the leading cause of injury among youth aged 15 years and older.^[4] It is of utmost importance to prognosticate the patient for the sake of patient's relatives as well as channelling of healthcare resources in today's overburdened hospitals. Various guidelines have been issued by the neurosurgical societies to immediately assess and intervene when ever required. In modern world, CT scan also plays an important role in guiding the management and many prognostic algorithms have been proposed using the same. In this study, we have tried to assess various clinical and radiological findings and their role in prognosis of the RTA patients.

We wanted to evaluate the basal cisterns effacement on CT scan of head in patients with traumatic head injuries by RSA or by any other mode and correlate the degree of basal cisternal effacement with the prognosis of the patient.

METHODS

Prospective study was done in Emergency department, Maharishi Markandeshwar Institute of Medical Sciences and Research and the Department of Radiodiagnosis, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Ambala in 100 patients with traumatic head injury due to road side accident or by any other mode of trauma like

violence or fall etc. and undergoing CT Scan of head at presentation or within 48 hours of presentation and GCS of ≤ 14 . Sample size was kept 100 because it is a fairly good sample size which would improve the power of study. Study was approved by ethical committee.

GCS, age, pupil reactivity and vitals were noted. Non-contrast enhanced CT examinations were performed on Philips Ingenuity 128 multislice spiral whole-body scanner. The examination was carried out with the patient in supine position on the CT table and head kept stationary in the head rest. Sections were taken in the axial plane. Scanning was done with thickness of 1 mm and increment of 0.50 mm. 329 images were obtained in direction of feet to head with the exposure factor of 120 KV and 350 mAs with the brain standard filter (UB). CT Head was studied specifically to look for perimesencephalic basal cistern and its degree of obliteration as defined below-^[5]

1. Complete Obliteration: Cisterns no longer visible as CSF (cerebrospinal fluid) spaces.
2. Partial Obliteration: Cisterns visible as hypodense slits, usually in one hemisphere.
3. No Obliteration: Cisterns visible as normal in both the hemispheres.

Other basal cisterns (interpeduncular cistern, ambient cistern, quadrigeminal plate cistern, superior cerebellar cistern and suprasellar cistern) were also studied and their degree of obliteration was noted down. Any midline shift or associated bony head injury was also noted. Patients were followed till discharge and their outcomes were defined as follows-

Outcome Measures

1. Degree of obliteration of cisterns (interpeduncular cistern, ambient cistern, quadrigeminal plate cistern, superior cerebellar cistern and suprasellar cistern) classified as complete, partial or no obliteration.
2. Degree of disability at the time of discharge from the hospital defined by Glasgow Outcome Score (GOS).

Category and Definition- Glasgow Outcome Scale^[6]

- Good recovery: able to return to work or school
- Moderate disability: able to live independently; unable to return to work or school
- Severe disability: able to follow commands/unable to live independently
- Persistent vegetative state: unable to interact with environment; unresponsive
- Dead

Outcomes were classified as favourable (moderate disability or good recovery) and unfavourable (dead, vegetative state, or severe disability).

Statistical Analysis

To test for association between cistern status and outcome (degree of disability at discharge), chi-square test was used. A p-value of <0.05 was considered statistically significant. To test for correlation amongst various parameters like baseline GCS status, midline shift and degree of cisternal obliteration, Pearson's correlation coefficient was calculated. Statistical analysis was done using IBM SPSS Statistics Data Editor Version 20.0.0.

RESULTS

The minimum age of the patients was 05 years whereas the maximum age was 58 years. Majority of the patients (32%) were of the age group 31-40 years. The mean age of the patients was 30.94±11.665 yrs. Age factor was more predictive of mortality and survival than functional outcome in this study. Males outnumbered females in the study, with males being 78% and females being 22%. No definite association with any sex could be depicted. Out of 100 patients with traumatic head injury, road traffic accident was the most common mode of injury seen in 68% of the patient, followed by fall in 23% of patients. Other modes like violence and sports related injury seen in 6% and 3% of patients respectively

Absent pupillary reflex was associated with poor prognosis. 42% patients who had absent pupillary reflex showed unfavourable outcome, 20% patients who showed sluggish response had unfavourable outcome. So absent pupillary reflex correlated ($p < 0.001$) with unfavourable outcome. In patients with GCS (13-14), 75% patients had favourable outcome and 25% patients had unfavourable outcome. In patients with GCS (9-12), 55.6% patients had favourable outcome and 44.4% patients had unfavourable outcome. In patients with GCS (3-9), 17.9% patients had favourable outcome and 82.1% patients had unfavourable outcome. Thus, low GCS correlated well ($p < 0.001$) with the unfavourable outcome.

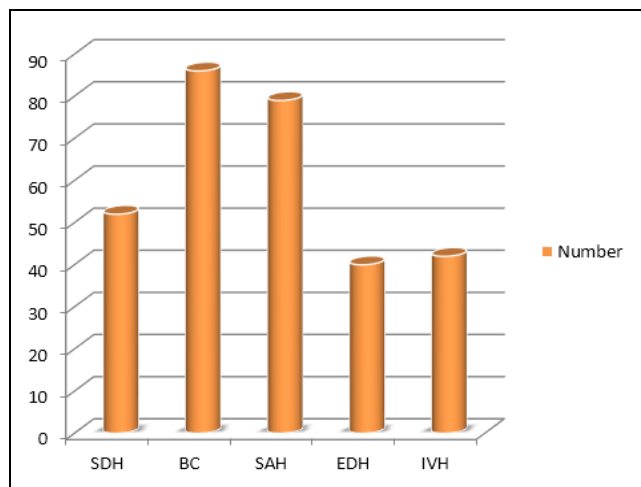


Figure 1. Frequency of Intracranial Bleed in TBI

SDH-Subdural Haemorrhage, BC-Brain Contusion, SAH-Subarachnoid Haemorrhage, EDH-Extradural Haemorrhage, IVH- Intraventricular Haemorrhage

Out of 100 patients, 43% patients had associated fractures related to head trauma; out of which 9% patients had favourable outcome whereas 34% patients had unfavourable outcome. 57% patients had no bone injuries out of which 27% patients had favourable outcome whereas 30% had unfavourable outcome. Brain contusion (86%) was the most common type of brain injury seen in patients with incidence of other types of intracranial bleed seen as given in fig 1. Other cisterns like ambient cistern, quadrigeminal cistern, suprasellar cistern and superior cerebellar cistern were assessed individually and results were found similar. Thus, assessing basal brain cisterns in traumatic head injury should make patient management much simpler and help the surgeons to accurately predict the outcome of the patient.

Degree of Obliteration	Peri Mesencephalic Cistern		Supra Sellar Cistern		Superior Cerebellar Cistern	
	Favourable %	Unfavourable %	Favourable %	Unfavourable %	Favourable %	Unfavourable %
Normal	14.0	4.0	22.0	12.0	30.0	18.0
Part. OBL.	22.0	26.0	14.0	28.0	6.0	26.0
OBL.	0.0	34.0	0.0	24.0	0.0	20.0

Table 1. Influence of Obliteration of Various Cisterns on Outcome

In our study, 36% of patients had favourable outcome (good recovery and moderate disability) out of which none of the patients had obliterated perimesencephalic cisterns. 64% patients had unfavourable outcome (severe disability, vegetative state and death) out of which 60 had obliterated or partially obliterated cisterns and only 4 had normal perimesencephalic cisterns.

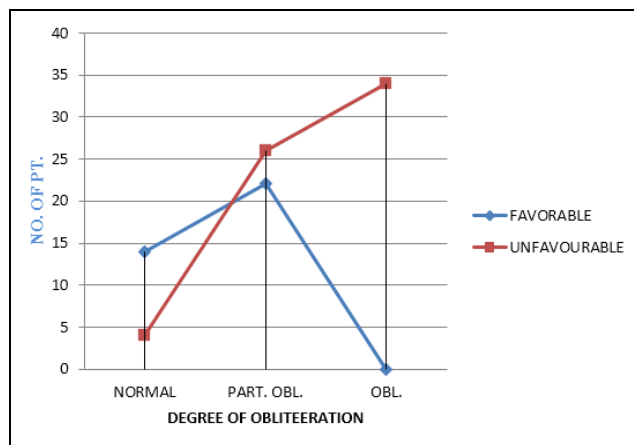


Figure 2. Correlation of Degree of Obliteration of Perimesencephalic Cistern with Outcome

Interpeduncular Cistern

In our study, 36% of patients had favourable outcome (good recovery and moderate disability) out of which none of the patients had obliterated interpeduncular cisterns. 64% patients had unfavourable outcome (severe disability, vegetative state and death) out of which 48% had obliterated or partially obliterated interpeduncular cisterns and only 16% had normal cisterns. Degree of disability and final outcome was correlated with degree of obliteration of interpeduncular cisterns using chi square test. It correlated well (p value < 0.001), with greater degree of obliteration of cistern predicting unfavourable outcome.

Ambient Cistern

In our study, 36% of patients had favourable outcome (good recovery and moderate disability) out of which none of the patients had obliterated ambient cisterns. 64% patients had unfavourable outcome (severe disability, vegetative state and death) out of which 46% had obliterated or partially obliterated ambient cisterns and only 18% had normal cisterns. In our study, most patients with normal cistern had favourable outcome, while the majority of patients with obliterated cistern had unfavourable prognosis

Quadrigeminal Cistern

In our study, 36% of patients had favourable outcome (good recovery and moderate disability) out of which none of the patients had obliterated quadrigeminal cisterns. 64% patients had unfavourable outcome (severe disability, vegetative state and death) out of which 54% had obliterated or partially obliterated quadrigeminal cisterns and only 10% had normal cisterns.

Obliteration of other cisterns, (including interpeduncular, ambient, quadrigeminal plate, suprasellar and superior cerebellar cisterns) also correlated with the final outcome. Thus, obliteration of each of the cisterns individually correlated significantly with the degree of disability and the final outcome (with p value consistently <0.001).

DISCUSSION

Traumatic head injury (THI) is a real social problem and is leading cause of morbidity, mortality and disability.^[7] Its important to assess and grade the TBI as soon as possible, to guide the management and decrease the comorbidities. The clinical prognostic indicators like GCS score, pupil reactivity, signs of increased ICP, age of patient and alcohol or drug intoxication have been proposed.^[8] CT plays a primary role in the acute setting of head trauma, allowing accurate detection of lesions requiring immediate neurosurgical treatment.^[9]

The mean age of the patients was 30.94±11.665 yrs. Age factor was more predictive of mortality and survival than functional outcome in our study. According to earlier studies by Davis et al^[10] and Pillai et al^[11] and our study, age is significantly associated with unfavourable outcome. No significant association between outcome of traumatic brain injury outcome and gender was seen in our study and earlier studies (ode bode et al^[12] and Morrison et al^[13]) done before. In our study as well as studies by Ode bode et al,^[12] Pillai et al^[11] and Roveliás et al^[14] absent pupillary reflex was associated with unfavourable outcome and poor prognosis. In our study as well as earlier study done by SLEWA-YOUNAN et al^[15] and POON et al,^[16] low GCS was found to be significantly associated with unfavourable outcome of the patient. IVH was seen in 42 patients out of which 74% had unfavourable outcome, so presence of IVH prognosticated poor outcome. In present study out of 36% patients showing favourable outcome only 4% had midline shift. Thus, most of the patient with favourable outcome had absent midline shift which was in concordance with previously done studies by Athiappan et al^[17] and by Oremakinde et al^[18] Most of the patient with favourable outcome had absent midline shift.

In present study, the degree of disability and final outcome correlated with degree of obliteration of basal perimesencephalic cisterns (including interpeduncular, ambient, quadrigeminal plate), suprasellar and superior cerebellar cisterns with greater degree of obliteration of cisterns predicting unfavourable outcome. Whether we can use perimesencephalic cisterns as a group or we can just use a single cistern is something that has to be evaluated further in future studies. Comparison of our study with previous similar studies in literature (table 2) showed similar results. Done by Oremakinde et al,^[18] in patients with obliterated cisterns,

76.9% patients had poor outcome and 23.1% had favourable outcome. In a study done by Jacobs et al,^[21] in patients with compressed and absent cisterns, 46.7% had unfavourable outcome. In a study done by Athiappan et al,^[17] in patients with obliterated cisterns, 76% had unfavourable outcome. In a study done by Selladurai et al,^[19] in patients with obliterated cisterns, 89.3% had unfavourable outcome.

Year of Publication and Study Reference	Incidence	Unfavourable Outcome %
Selladurai et al ^[19]	74/109; 67.8%	89.3%
Grandstaff et al ^[20]	472/819; 57.6%	-
Oremakinde et al ^[18]	13/150; 8.7%	76.9%
Jacobs et al ^[21]	265/567; 46.7%	46.7%
Athiappan et al ^[17]	82/107; 76%	76%
Present study	82/100; 82%	64%

Table 2. Incidence of Compressed or Absent Basal Cisterns and Unfavourable Outcome

Limitations

The limitations of the study were small sample size and that it was a single centre study; so results need to be verified at multiple centres in different population.

CONCLUSIONS

It is important to investigate, grade and prognosticate traumatic head injury patients at the earliest. Our study and various other studies prove that various clinical predictors including age, Glasgow coma scale, and pupil reactivity correlate with outcome of the patient. Easy and early availability of imaging modalities like CT scan has ushered a great interest in using this for predicting the prognosis. Presence of midline shift, intraventricular haemorrhage, and obliteration of cisterns in patients of traumatic brain injury also correlate with the outcome and can be used; thus, making the prognostication process much easier. These findings can be used on the first day of admission itself, and at the same time doesn't require any complicated and time-consuming algorithms and hence can simplify the patient management by predicting prognosis. Numerous computer-based algorithms and scoring systems have been proposed; though definitely useful, they are cumbersome and may not be useful in day to day setting.

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